PROCESS FLOWCHART
AND
PORCESS DESCRIPTION

Attachment L

Information Request #6

6. PRODUCTION PLAN

6.1 Flowsheet and Process Description

The target end-product for the first year of operation will be cobalt sulfate solution containing 8 % cobalt.

The production of cobalt sulfate solution involves two key steps: dissolution of cobalt in sulfuric acid followed by purification by removing impurity metals. This last step is not necessary if virgin metal is used.

If a crystal product is desired at a later date, the additional steps of crystallization, drying and packaging will also be required.

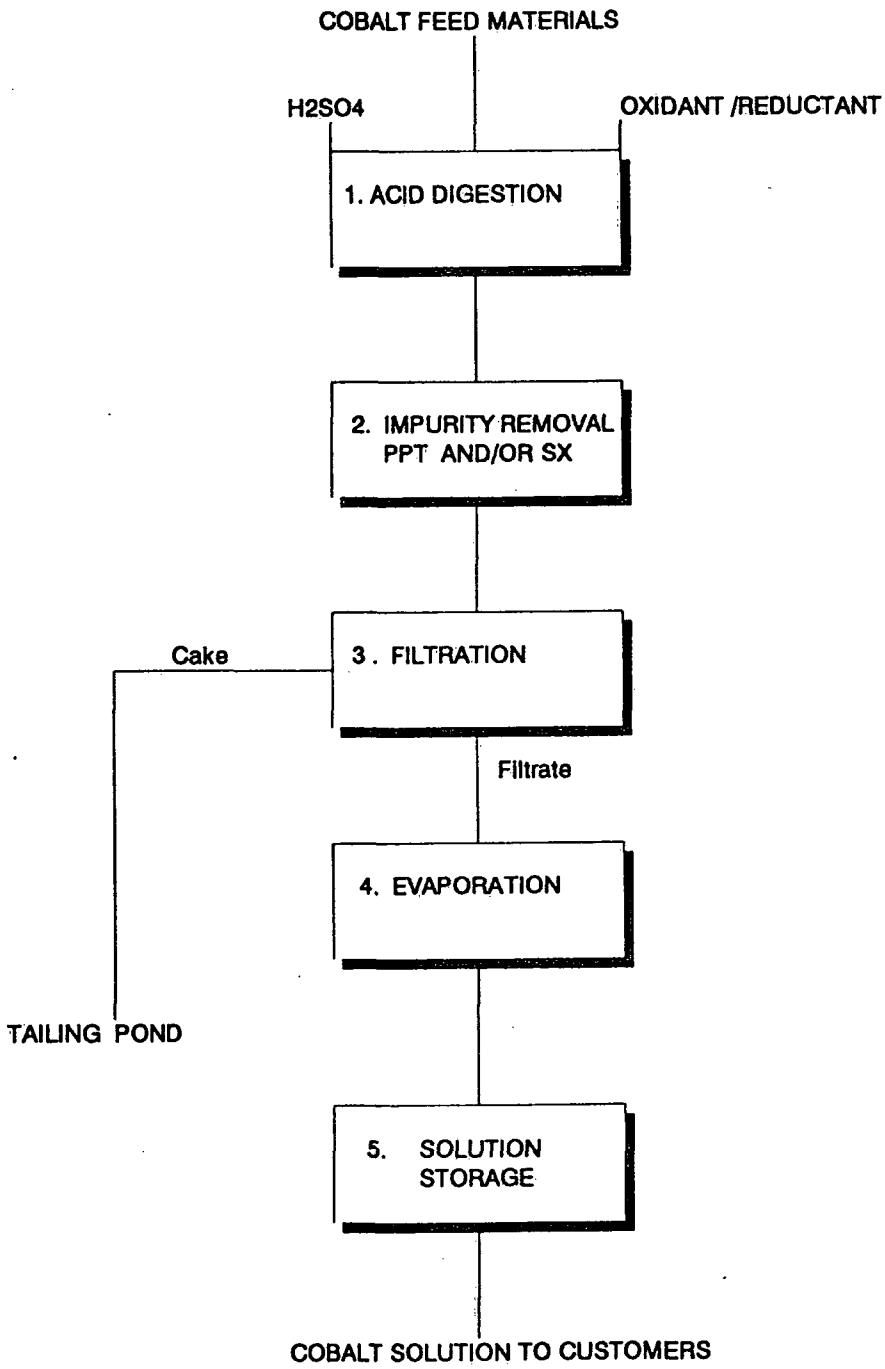
The process is shown by the block diagram flowsheet in Figures 6.1 and 6.2.

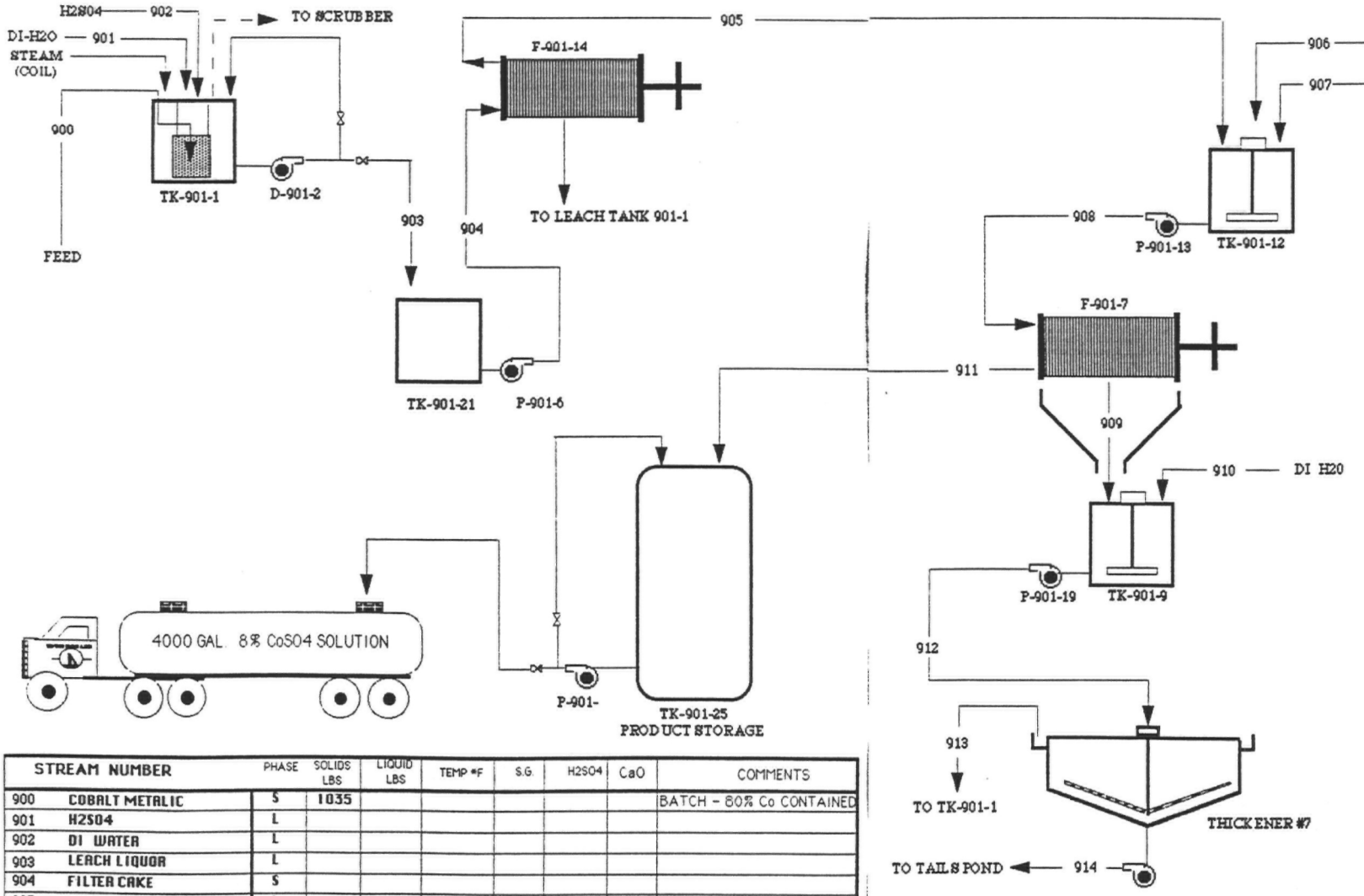
The dissolution rate of cobalt metal or cobalt oxide is influenced primarily by the oxidation state as well as the surface area of the feed material. An oxidant such as hydrogen peroxide or reductant, such as sugar is added to speed up the digestion. Generally the desirable cobalt concentration of the solution can be reached in less than 8 hours at an elevated temperature (80 to 100 oC). Dissolution difficulties have recently been encountered by some domestic cobalt sulfate producers with Russian cobalt ingots due to the low surface area of the material.

The impurity metals such as iron, aluminum and chromium are usually removed by precipitation at a Ph of 5.

A final adjustment of the solution strength is usually required before storage. This will be accomplished by either evaporation or dilution. There is little risk of crystallization or other product degradation during storage and shipment.

PROCESS FLOWSHEET FOR COBALT SULFATE PRODUCTION





ITEM	HP	DESCRIPTION	EQ.#	
1		1130 GAL. FRP TANK	TK-901-1	EX
2	AIR	DEPA	D-901-2	EX
3	1	8'X 8' FRP TANK	TK-901-21	EX
4		1 1/2" X 1" GOULDS	P-901-6	EX
5	AIR	24" FILTER PRESS	F-901-14	EX
6	5	1130 GAL FRP TANK	TK-901-12	EX
7	5	1 1/2" X 1" GOULDS	P-901-13	EX
8	AIR	24" FILTER PRESS	F-901-7	EX
9	7.5	1545 GAL TANK	TK-901-9	EX
10		10,000 GAL TANK	TK-901-25	EX
11	1	20" X 10" THICKENER	TH-# 7	EX
12	5	2" FYB SUMP PUMP	P-901-19	EX

EX-EXISTING

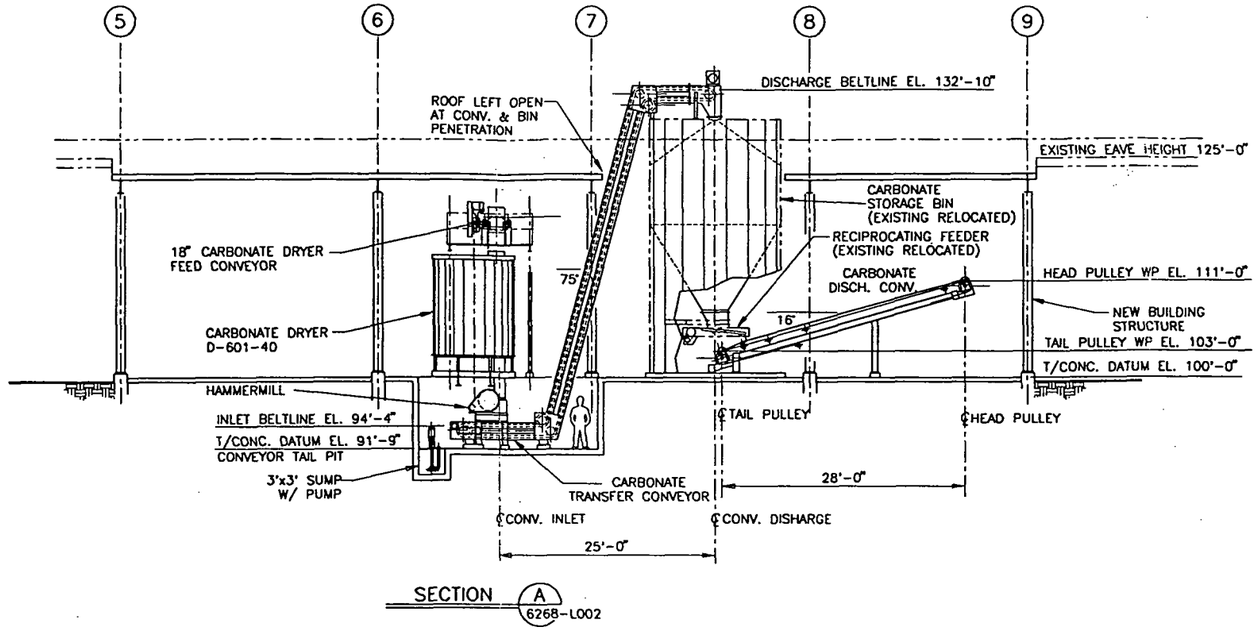
STREAM NUMBER		PHASE	SOLIDS LBS	LIQUID LBS	TEMP °F	S.G.	H2SO4	CaO	COMMENTS
900	COBALT METALIC	S	1035						BATCH - 80% Co CONTAINED
901	H2SO4	L							
902	DI WATER	L							
903	LEACH LIQUOR	L							
904	FILTER CAKE	S							
905	FILTRATE	L							
906	LIME	L							
907	PEROXIDE	L							
908	pH ADJUSTED LIQUOR	L							
909	FILTER CAKE	S							
910	FILTRATE	L							
911	DI WATER	L							
912	WASTE SLURRY	L							
913	THICKENER OVERFLOW	L							
914	THICKENER UNDERFLOW	S							

HECLA MINING COMPANY

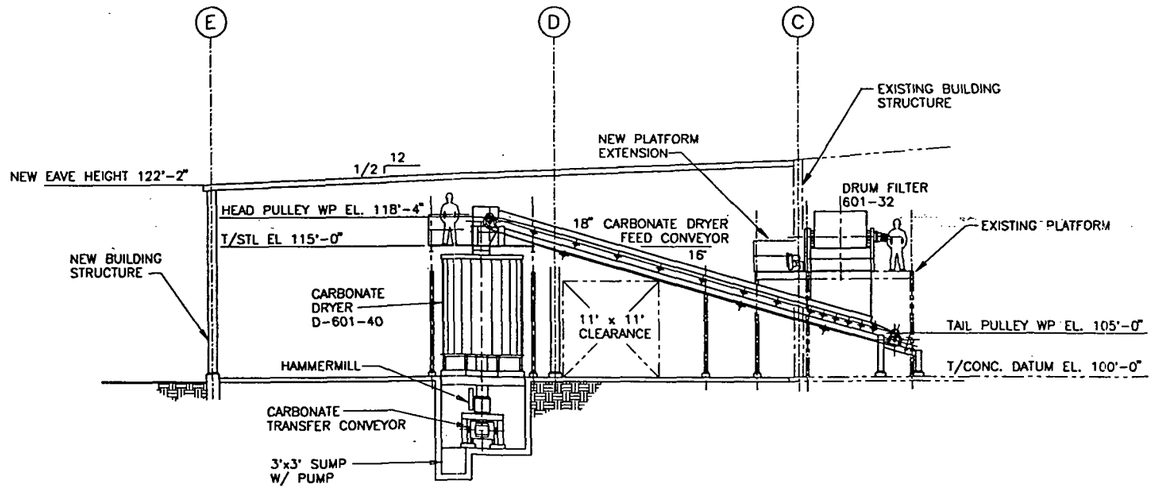
APEX UNIT

COBALT SULFATE PROJECT

DRAWN BY: JB BESS
APPROVED BY: BRENT WILLOUGHBY
DATE
DRAWING NUMBER: Co -901



SECTION A
6268-L002



SECTION B
6268-L002

LEGEND

- EXISTING EQUIPMENT & STRUCTURES
- EXISTING EQUIP. RELOCATED OR REUSED
- NEW EQUIPMENT & STRUCTURES

REV.	DATE	BY	CHECK	DESCRIPTION OF REVISION
B	1/5/94	JAP		ISSUED FOR REPORT
A	12/23/93	JAP		ISSUED FOR REVIEW

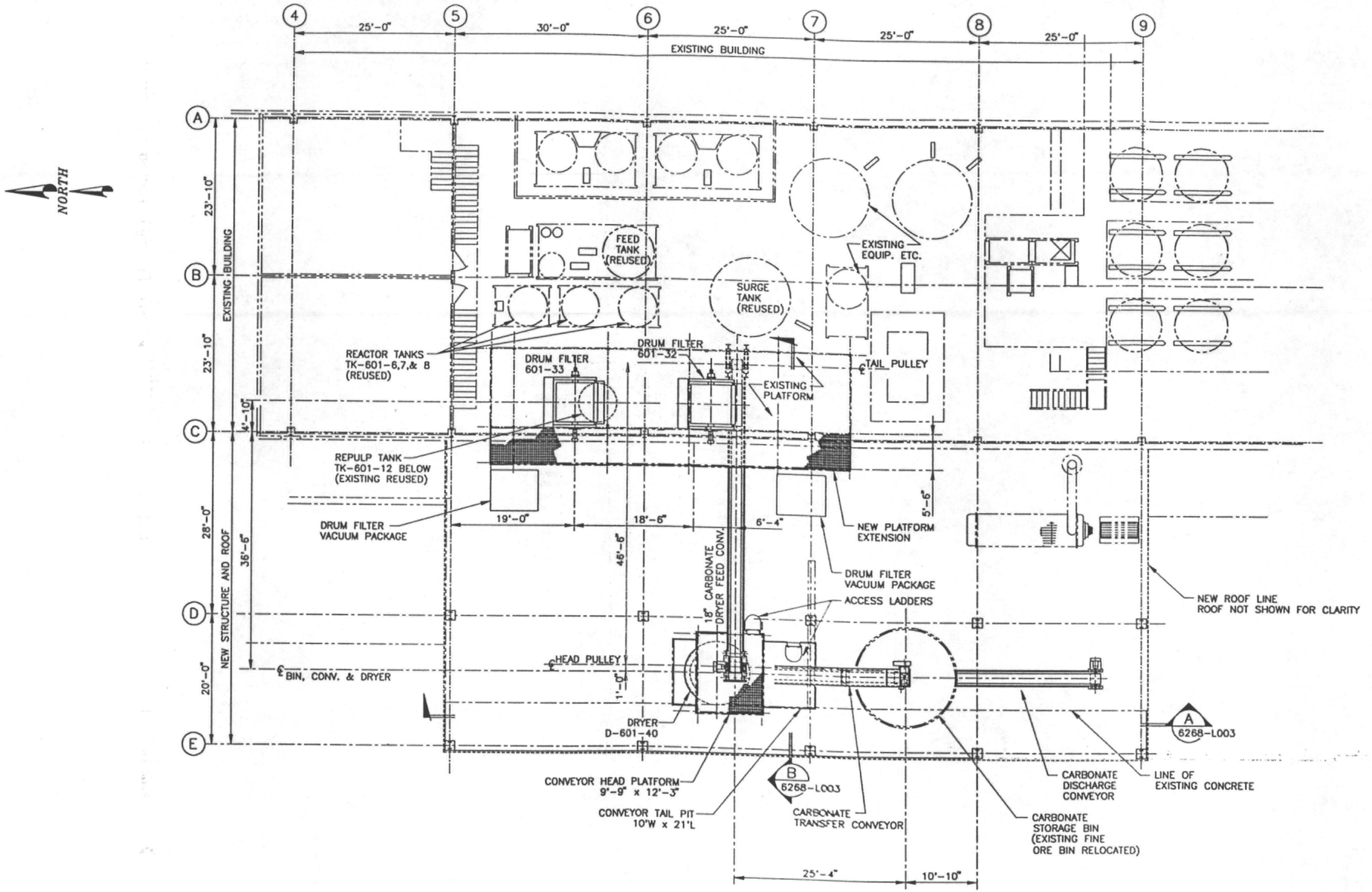
ROBERTS & SCHAEFER Company
ENGINEERS AND CONTRACTORS
CHICAGO-PITTSBURGH-SALT LAKE CITY | R&S JOB #6268

DRAWN BY J.A.PETERSON
CHECKED BY
APPROVED BY

GENERAL ARRANGEMENT ELEVATIONS
COBALT CARBONITE
HECLA MINING COMPANY
APEX UNIT, ST. GEORGE UT

SCALE 1/8" = 1'-0" | DATE 12/16/93
DRAWING NO. 0601-M002 | REV. B

0601M002 01/13/94 16:45 JDEP



LEGEND

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REV.	DATE	BY	CHECK	DESCRIPTION OF REVISION
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ENGINEERS AND CONTRACTORS
CHICAGO-PITTSBURGH-SALT LAKE CITY
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GENERAL ARRANGEMENT PLAN
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